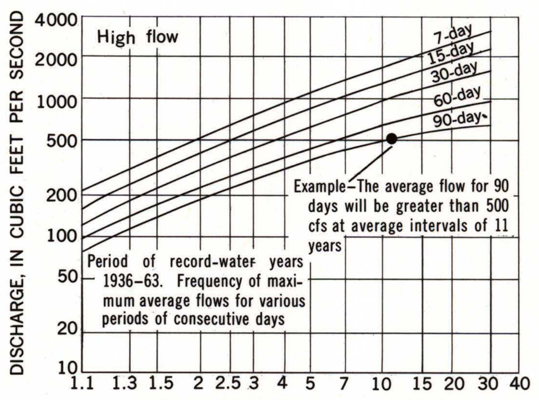
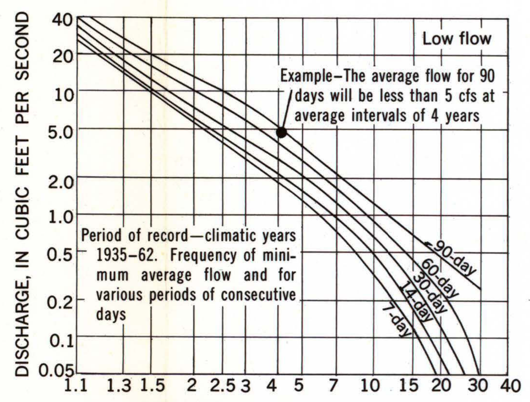
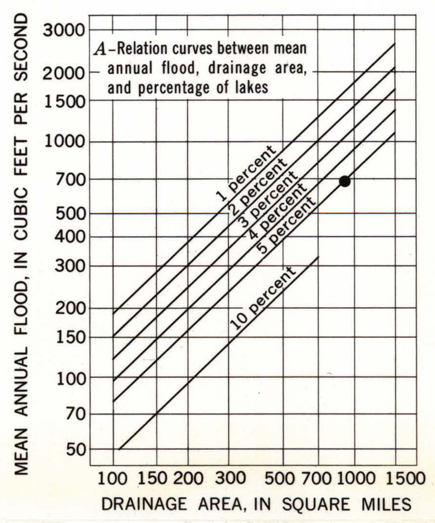
PREPARED IN COOPERATION WITH
THE MINNESOTA DEPARTMENT OF CONSERVATION
DIVISION OF WATERS

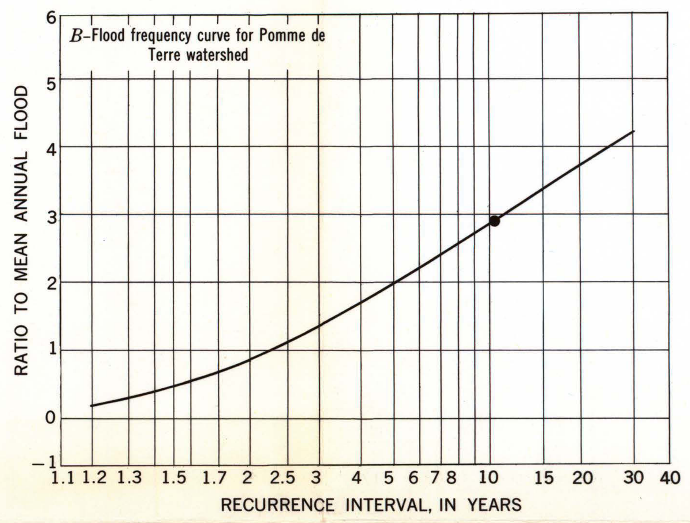
SURFACE WATER





DURATION AND OCCURRENCE OF HIGH AND LOW FLOW ARE SHOWN FOR THE POMME DE TERRE RIVER AT APPLETON.—*High flow is from storms or snow melt and is influenced by basin shape and topography whereas low flow is largely from ground-water sources and is less influenced by terrain features. The low-flow frequency curves for upstream sites would differ from these shown because of variations in surficial geology. Curves of summer low flow frequency would also be of different shape because winter freezeup is the primary cause of the no-flow periods*





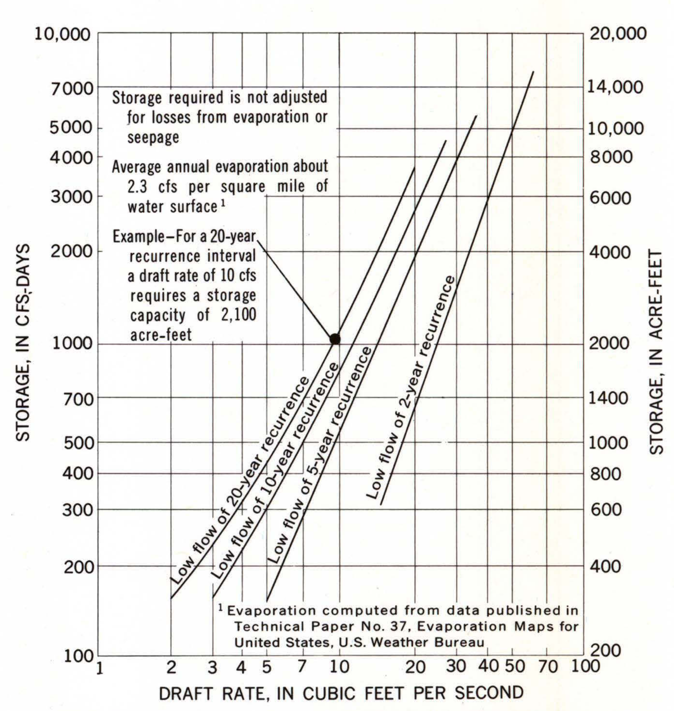
THE RECURRENCE INTERVAL OF A FLOOD OF SELECTED MAGNITUDE CAN BE DETERMINED BY USE OF FLOOD FREQUENCY AND RELATION CURVES

Example—

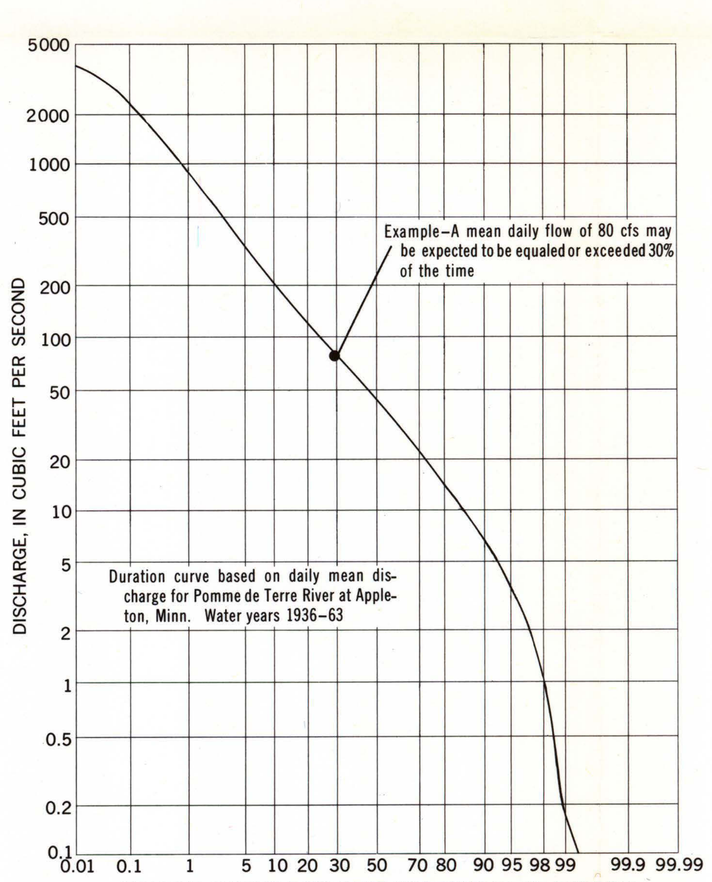
Find the recurrence interval of a flood of 2000 cfs at a site of 900 square miles drainage area of which 5% is lakes.

1. *The 5% curve in diagram (A) shows that for a drainage area of 900 square miles the mean annual flood is 690 cfs.*
2. *The ratio of the 2000 cfs flood to the mean annual flood of 690 cfs is 2000/690=2.90.*
3. *Entering diagram (B) with a ratio of 2.90, the flood frequency curve shows that the 2000 cfs flood will occur on an average once every 10 years.*

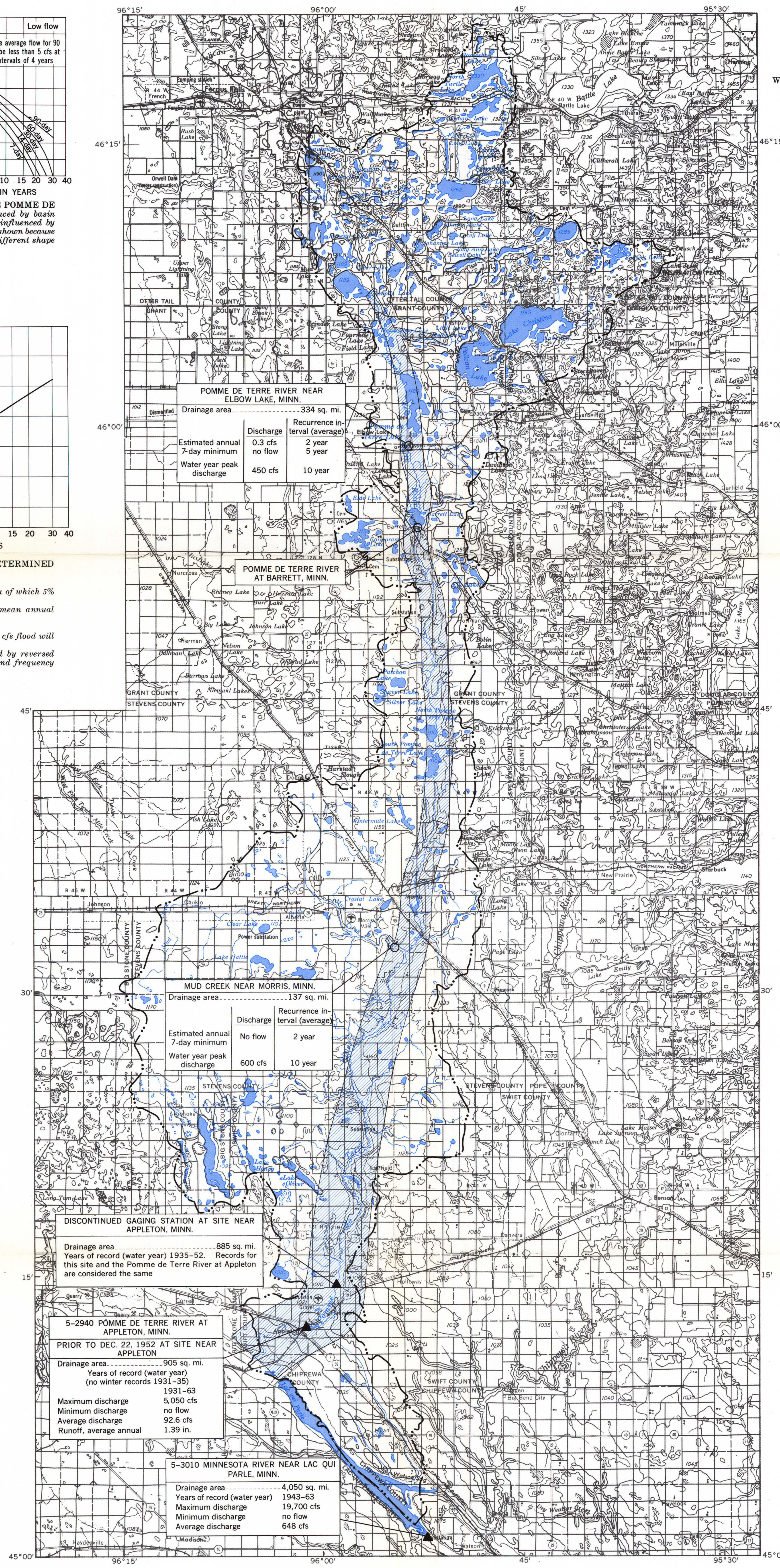
The magnitude of a flood at a specified recurrence interval at this same site can also be found by reversed procedure. Relation curves (1% to 5%) from Prior and Hess (1961). The 10% curve and frequency curve modified for this report from the same source



THE DRAFT-STORAGE-FREQUENCY RELATION CURVES FOR POMME DE TERRE RIVER AT APPLETON SHOW THE APPROXIMATE STORAGE THAT WOULD BE NECESSARY TO MAINTAIN SPECIFIED FLOWS FOR VARIOUS LOW-FLOW RECURRENCE INTERVALS.—*Low streamflow can be increased by release of water stored during high-flow periods*



THE EFFECTS OF STORAGE IN LAKES, CHANNELS, AND GLACIAL DEPOSITS IS SHOWN BY THE RELATIVELY MODERATE SLOPE OF THE MIDDLE AND UPPER END OF THE DURATION CURVE.—*Low flow below the 95 percent point is primarily the result of freezeup and does not represent depletion of ground-water storage*

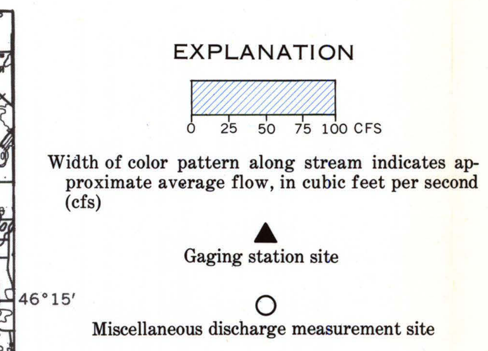


Base from Army Map Service, 1:250,000 series

SCALE 1:250 000

CONTOUR INTERVAL 50 FEET
DATUM IS MEAN SEA LEVEL

THE AVERAGE FLOW DIAGRAM SHOWS THE MAXIMUM QUANTITY OF WATER THAT COULD BE DEVELOPED FOR A WATER SUPPLY.—Water losses in transmission and lack of suitable reservoir sites prevent utilization of the average streamflow. Most of the lakes are in the northern third of the watershed and are effective in reducing peak flows. The average discharge per square mile from the northern third (lake region) is approximately equivalent to that from the lower part of the watershed



RESERVOIRS

Reservoir	Usable contents (in acre-feet)	Surface area at normal capacity stage (in acres)	Mean annual evaporation (in cfs)
Marsh Lake	35,000	5,100	19
Lacqui Parle	102,900	6,400	24

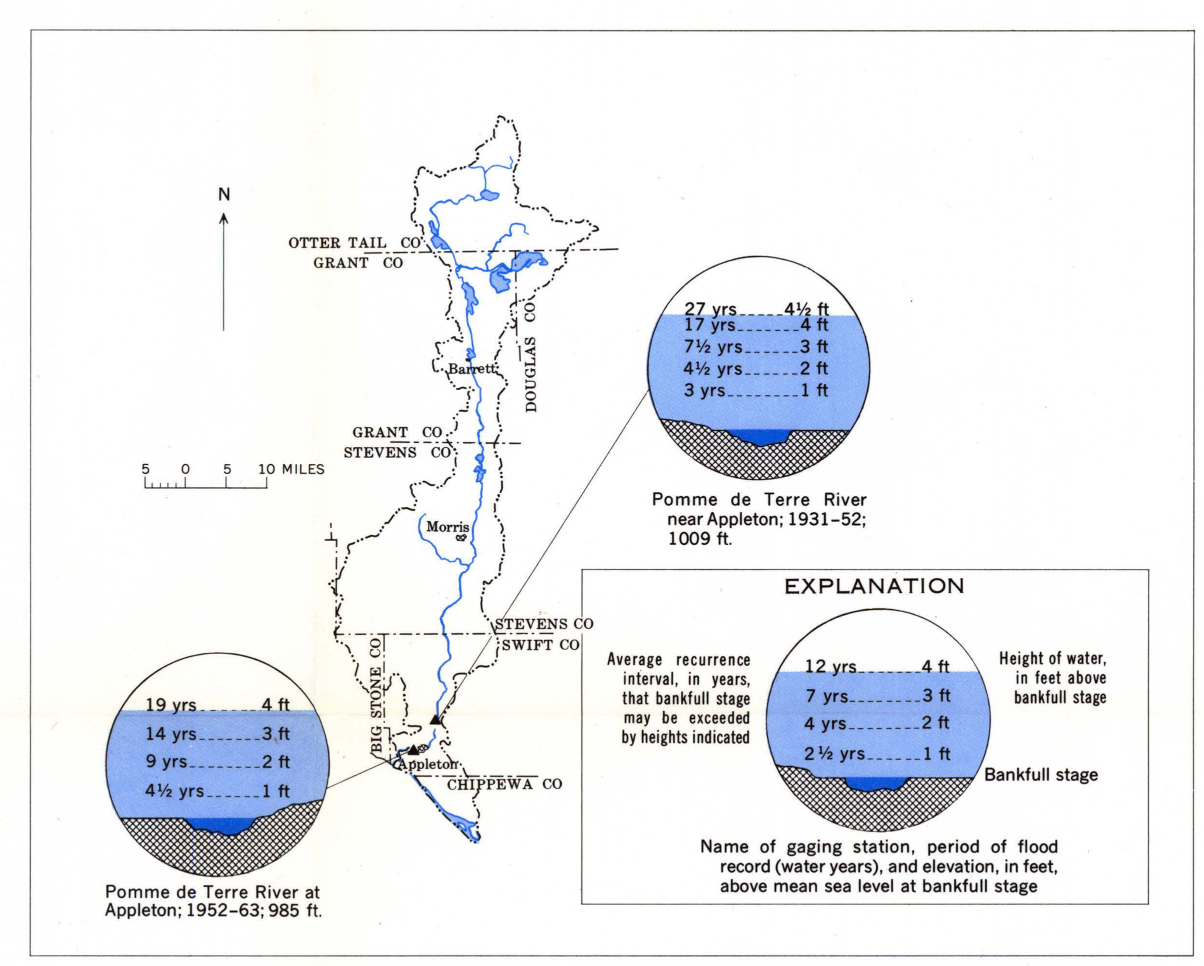
Data on reservoir contents and surface area furnished by the Corps of Engineers, U.S. Army. The mean annual evaporation computed from data published in Technical Paper No. 37, Evaporation Maps for United States, U.S. Weather Bureau

SELECTED LARGE LAKES
[Data obtained from Minnesota Department of Conservation except as footnote]

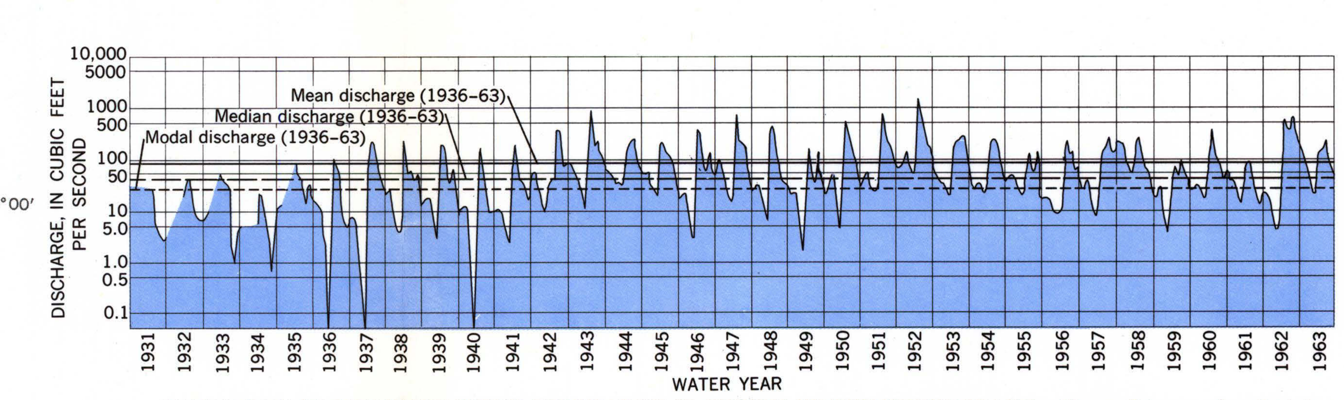
Name	Surface area (acres)	Length of shoreline (miles)	Depth (feet) Maximum	Depth (feet) Median or average	Outlet control	Fish and game classification	Problem
North Turtle	1,603	17	10	–	No surface outlet	Game fish	Lack of inflow
Stalker	1,314	[1] 7.0	95	–	Fixed concrete stop logs	Walleyed pike	
Tenmile (north)	667	5.5	15	5	Natural channel into South Tenmile Lake	Waterfowl and muskrat	Fish winterkill
Tenmile (south)	1,445	9.6	51	15	Fixed concrete stop logs	Walleyed pike, pan fish, and bass	
Christina	3,949	15	14	4	Fixed crest dam	Migratory waterfowl, especially canvas back and other diving ducks, pan and rough fish	
Pelican	3,680	27	21	10	Fixed crest dam	Walleyed pike and pan fish, waterfowl	
Pomme de Terre	1,794	[1] 13	22	–	Fixed concrete stop logs	Walleyed pike and pan fish, waterfowl	Semipermanent lake, partial fish kill each winter
Barrett	517	5.6	25	8	Wooden stop logs in concrete dam	Walleyed pike and rough fish	Periodic fish winterkill
Artichoke	2,011	9.5	13	–	Natural channel	Game and rough fish, migratory waterfowl	Fish winterkill, no waterfowl breeding ground, large fluctuation in lake level

[1] From U. S. Geological Survey topographic maps

Major lakes in the watershed are an important recreational asset. These lakes coincide with the piezometric surface and are relatively stable (see sheet 2). Little use is made of the approximately 100 minor lakes in the area for water supply, but many provide fish and wildlife habitats. They are used principally for hunting, fishing, and water sports. Where perched above the piezometric surface, they are subject to large changes in volume and may dry up during minor droughts



HEIGHT AND FREQUENCY OF FLOODING AT GAGING SITES CAN BE RELATED TO LOCATIONS IN THE VICINITY OF THE GAGE BY USE OF TOPOGRAPHIC MAPS TO DETERMINE CHANNEL SHAPE.—*Because the gaging station has been operated at two sites, the stage-frequency relation is defined for both. The maximum flood for period of record (1952) has been used in the relationship for both locations*



VARIATION IN MEAN MONTHLY DISCHARGE IS SHOWN BY THE HYDROGRAPH.—*Streamflow records collected on the Pomme de Terre River near Appleton for water years 1931–52 (no winter records 1931–35) and at Appleton 1953–63 are considered equivalent although there is a small difference during periods of low flow. No flow has been recorded, as the result of freezeup, for 176 days during the winters of 1936, 1937, and 1940, and for one day during the winter of 1942. During the open-water seasons, including the severe drought of the early 1930's, there were only 3 days of no flow*

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—1966—W66120

WATER RESOURCES OF THE POMME DE TERRE RIVER WATERSHED, WEST-CENTRAL MINNESOTA

By
R. D. Cotter and L. E. Bidwell

1966